Claims

[c1] 1. A method of providing for cooling a gas turbine engine, comprising:

a. providing for supplying fuel to a rotatable portion of the gas turbine engine, wherein said rotatable portion comprises a rotor and at least one blade operatively coupled to or a part of said rotor;
b. providing for cooling at least one of said rotor and at least one said blade with said fuel supplied to said rotatable portion, wherein said at least one said blade is closed with respect to a combustion chamber of the gas turbine engine relative to said fuel supplied to said at least one said blade; and
c. providing for discharging said fuel from said rotatable portion directly into a combustion chamber of the gas turbine engine.

[c2] 2. A method of providing for cooling a gas turbine engine as recited in claim *1*, wherein said rotatable portion comprises a rotary fluid trap, said fuel is supplied to an inlet of said rotary fluid trap, and an outlet of said rotary fluid trap is in fluid communication with said rotor.

[c3] 3. A method of providing for cooling a gas turbine en-

gine as recited in claim *1*, wherein the operation of providing for cooling comprises providing for flowing said fuel along at least one first flow path between a first side of said rotor and a second side of said rotor.

[c4] 4. A method of providing for cooling a gas turbine engine as recited in claim *3*, wherein the operation of providing for cooling further comprises providing for thermosiphon exchange of fuel between said at least on first flow path and at least one second flow path, wherein said at least one second flow path extends within said at least one said blade so as to provide for a transfer of heat from said at least one said blade to said fuel, whereby said thermosiphon exchange is responsive to a centrifugal acceleration field generated by a rotation of said rotatable portion, and said thermosiphon exchange is further responsive to a variation in density of said fuel responsive to the temperature thereof.

[c5] 5. A method of providing for cooling a gas turbine engine as recited in claim *4*, wherein a shape of said at least one first flow path is adapted to at least partially conform to a profile of said at least one said blade, said at least one second flow path is substantially linear in direction, and said shape of said at least one first flow path provides for an intersection of said at least one second flow path with said at least one first flow path.

[c6] 6. A method of providing for cooling a gas turbine engine as recited in claim 4, wherein the operation of providing for cooling further comprises:

a. providing for a plurality of said second flow paths within at least one said blade, and

b. providing for said plurality of said second flow paths to communicate with one another proximate to a second end of said second flow paths that is distal to first end that is in communication with said at least one first flow path.

[c7] 7. A method of providing for cooling a gas turbine engine as recited in claim 3, wherein the operation of discharging said fuel comprises flowing said fuel out of said second side of said rotor from said first flow path to a discharge location that is radially inward of said first flow path.

[c8] 8. A method of providing for cooling a gas turbine engine as recited in claim 4, wherein the operation of discharging said fuel comprises flowing said fuel out of said second side of said rotor from said first flow path to a discharge location that is radially inward of said first flow path.

[c9] 9. A method of providing for cooling a gas turbine en-

gine as recited in claim *1*, wherein said fuel is discharged into said combustion chamber from a rotary injector operatively coupled to a shaft portion of said rotatable portion.

[c10] 10. A method of providing for cooling a gas turbine engine as recited in claim *1*, wherein said fuel is discharged into said combustion chamber from a rotary injector operatively coupled to a cavity adjacent to said rotor, and said cavity receives said fuel from said rotor that has been heated as a result of the operation of cooling.

[c11] 11. A method of providing for cooling a gas turbine engine, comprising:

a. providing for flowing a fluid along at least one first flow path from a first side of a rotor of said gas turbine engine to a second side of said rotor; and

b. providing for thermosiphon flow of said fluid within at least one second flow path, wherein said at least one second flow path is in fluid communication with said at least one first flow path, said at least one second flow path is in thermal communication with at least one blade operatively couple to or a part of said rotor; and said at least one first flow path is adapted so that said fluid can flow therealong without necessarily flowing along said at least one second flow path.

[c12] 12. A method of providing for cooling a gas turbine engine as recited in claim *11*, wherein said at least one second flow path extends within said at least one said blade.

[c13] 13. A method of providing for cooling a gas turbine engine as recited in claim *11*, wherein a shape of said at least one first flow path is adapted to at least partially conform to a profile of said at least one said blade, said at least one second flow path is substantially linear in direction, and said shape of said at least one first flow path provides for an intersection of said at least one second flow path with said at least one first flow path.

[c14] 14. A method of providing for cooling a gas turbine engine as recited in claim *11*, wherein said at least one second flow path comprises a plurality of said second flow paths within at least one said blade, further comprising providing for said plurality of said second flow paths to communicate with one another proximate to a second end of said second flow paths that is distal to first end that is in communication with said at least one first flow path.

[c15] 15. A method of providing for cooling a gas turbine engine as recited in claim *11*, wherein said at least one first

flow path comprises a plurality of first flow paths and at least one of said plurality of first flow paths is not in fluid communication with said at least one second flow path.

[c16] 16. A method of operating a gas turbine engine, comprising

a. rotating a rotor of the gas turbine engine;

b. supplying at least a first portion of fuel to a first cavity on a first side of said rotor of the gas turbine engine, wherein said first cavity rotates with said rotor;

c. causing said fuel supplied to said first cavity to rotate with said first cavity, whereby the rotation of said fuel generates a centrifugal acceleration that acts upon said fuel in said first cavity;

d. flowing said fuel into a first flow path through a first opening on a first side of said rotor;

e. flowing said fuel from said first flow path into a second flow path, wherein said second flow path extends into a blade operatively coupled to or a part of said rotor, and the operations of flowing said fuel into said first flow path and from said first flow path into said second flow path are responsive to said centrifugal acceleration;

f. transferring heat from said blade to said fluid in

either said first flow path or said second flow path so as to generate a relatively heated fluid therein;

g. flowing said relatively heated fluid from said second flow path to said first flow path by a thermosiphon process whereby said relatively heated fluid is replaced with a relatively less heated fluid;

h. flowing said relatively heated fluid from said first flow path through a second opening on a second side of said rotor to a second cavity on said second side of said rotor;

i. flowing said relatively heated fluid from said second cavity to an orifice operatively associated with a combustion chamber of said gas turbine engine; and

j. discharging said heated fluid from said orifice into said combustion chamber.

[c17] 17. A method of operating a gas turbine engine as recited in claim *16*, wherein the operation of supplying fuel to said first cavity comprises:

a. discharging said fuel from a first orifice to an inlet of a first rotary fluid trap; and

b. discharging said fuel from an outlet of said first rotary fluid trap into said first cavity, wherein said first rotary fluid trap is adapted to rotate with said rotor; and said first rotary fluid trap provides for isolating a pressure at said inlet from a pressure at said

outlet.

[c18] 18. A method of operating a gas turbine engine as recited in claim *16*, wherein said first and second flow paths are adapted so that said relatively heated fluid is in a supercritical condition.

[c19] 19. A method of operating a gas turbine engine as recited in claim *16*, wherein the operation of discharging said heated fluid comprises discharging said heated fluid through a second rotary fluid trap, and said second rotary fluid trap provides for isolating a pressure of said heated fluid from a pressure of said combustion chamber.

[c20] 20. A method of operating a gas turbine engine as recited in claim *16*, further comprising supplying a second portion of said fuel to said combustion chamber over a separate flow path.

[c21] 21. A method of operating a gas turbine engine as recited in claim *20*, further comprising controlling said first portion of said fuel so as to inhibit a flow of said first portion of said fuel when said turbine engine is not sufficiently hot to cause a vaporization of said fuel within said first flow path.

[c22] 22. A method of operating a gas turbine engine as re-

cited in claim *20*, wherein said second portion of said fuel is adapted to be sufficient to maintain at least an idle operating condition of the gas turbine engine, and said first portion of said fuel is adapted to provide a remainder of said fuel to the gas turbine engine.

[c23] 23. A gas turbine engine, comprising:

a. a rotor;

b. a first cavity on a first side of said rotor, wherein said first cavity is adapted to receive fuel from a source of fuel, and said first cavity is formed between said first side of said rotor and a first bounding surface;

c. a second cavity on a second side of said rotor, wherein said second cavity is formed between said second side of said rotor and a second bounding surface; and said first and second bounding surfaces are adapted to rotate with said rotor;

d. at least one passage in fluid communication with both said first cavity and said second cavity, wherein said at least one passage extends into at least one blade operatively coupled to or a part of said rotor so as to provide for heat transfer from said at least one blade to said fuel in said at least one passage; and

e. at least one first discharge orifice in fluid communication with said second cavity, wherein said at least

one first discharge orifice is adapted to rotate with said rotor, said first discharge orifice is adapted to discharge fuel directly into said combustion chamber; and fuel discharged from said first discharge orifice is supplied to said first discharge orifice from said second cavity.

[c24] 24. A gas turbine engine as recited in claim *23*, further comprising a first rotary fluid trap operatively coupled to said first cavity, wherein said first rotary fluid trap is adapted to receive fuel from said source of fuel and said first cavity is adapted to receive fuel from said first rotary fluid trap.

[c25] 25. A gas turbine engine as recited in claim *23*, further comprising at least one relatively fixed orifice proximate to and separated from an inlet of said first rotary fluid trap, wherein said fuel from said source of fuel is discharged from said at least one relatively fixed orifice and captured by said inlet of said first rotary fluid trap when said first rotary fluid trap is rotated during operation of the gas turbine engine.

[c26] 26. A gas turbine engine as recited in claim *23*, wherein said first bounding surface is sealed to said rotor along a first periphery that surrounds every opening of said at least one first passage on said first side of said rotor;

and said second bounding surface is sealed to said rotor along a second periphery that surrounds every opening of said at least one first passage on said second side of said rotor.

[c27] 27. A gas turbine engine as recited in claim *23*, wherein said at least one passage comprises:

a. at least one first passage extending between said first cavity and said second cavity; and

b. at least one second passage extending from said first passage into at least one blade operatively coupled to or a part of said rotor.

[c28] 28. A gas turbine engine as recited in claim *27*, wherein a shape of said at least one first passage is adapted to at least partially conform to a profile of said at least one said blade, and said at least one second passage is substantially linear and said at least one second passage is adapted to intersect said at least one first passage.

[c29] 29. A gas turbine engine as recited in claim *28*, wherein said at least one second passage comprises a plurality of second passages within at least one said blade, said at least one said blade comprises a third cavity in fluid communication with said plurality of said second passages at second ends thereof, and wherein first ends of said plurality of second passages are operatively coupled

to said at least one first passage.

[c30] 30. A gas turbine engine as recited in claim *29*, wherein said third cavity is proximate to a tip of said at least one said blade.

[c31] 31. A gas turbine engine as recited in claim *23*, wherein said at least one first discharge orifice is operatively coupled to or a part of a shaft operatively coupled to said rotor.

[c32] 32. A gas turbine engine as recited in claim *23*, wherein said at least one first discharge orifice is operatively coupled to or a part of said second bounding surface.

[c33] 33. A gas turbine engine as recited in claim *23*, wherein said at least one first discharge orifice is operatively coupled to or a part of a second rotary fluid trap.

[c34] 34. A bladed rotor of a gas turbine engine, comprising

a. a rotor;

b. at least one blade operatively coupled to or a part of said rotor;

c. at least one first opening on a first side of said rotor;

d. at least one second opening on a second side of said rotor, wherein said second side is opposite to said first side;

e. at least one first passage, wherein said first passage is located in said rotor and provides for fluid communication between at least one said first opening and at least one said second opening; and

f. at least one second passage, wherein said at least one second passage is located in at least one said blade, one end of said at least one said second passage is in fluid communication with at least one said first passage and the other end of said at least one said second passage is located within said at least one said blade, said at least one first passage is adapted so that a fluid can flow between said at least one said first opening and said at least one said second opening without necessarily flowing in said at least one said second passage, said at least one second passage is adapted to provide for heat transfer from said at least one said blade to a fluid in said at least one second passage, and said at least one second passage is adapted to provide for thermosiphon flow of said fluid therewithin when said rotor is in operation.

[c35] 35. A bladed rotor of a gas turbine engine as recited in claim *34*, wherein said at least one first opening comprises a plurality of first openings, said at least one second opening comprises a plurality of second openings,

said at least one first passage comprises a plurality of first passages, and each of said first opening is operatively coupled to only one corresponding said second opening by a corresponding said first passage.

[c36] 36. A bladed rotor of a gas turbine engine as recited in claim *34*, wherein each said second passage is associated with only one said first passage.

[c37] 37. A bladed rotor of a gas turbine engine as recited in claim *34*, wherein a shape of said at least one first passage is adapted to at least partially conform to a profile of said at least one said blade, said at least one second passage is substantially linear, and said at least one second passage is adapted to intersect said at least one first passage.

[c38] 38. A bladed rotor of a gas turbine engine as recited in claim *37*, wherein said at least one second passage comprises a plurality of second passages within at least one said blade, said at least one said blade comprises a cavity in fluid communication with said plurality of said second passages at second ends thereof, and first ends of said plurality of second passages are operatively coupled to said at least one first passage, wherein said second ends are distal to said first ends.

[c39] 39. A bladed rotor of a gas turbine engine as recited in claim *38*, wherein said cavity is proximate to a tip of said at least one said blade.